1 574 412

PATENT SPECIFICATION

(11) 1 574 412

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(54) IMPROVEMENTS RELATING TO SUBSOIL-BREAKING IMPLEMENTS

(71) I, AINSLEY NEVILLE EDE, a British Subject, of 36 Thornton Way, Cambridge, Cambridgeshire, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is performed, to be particularly described in and by the following statement:—

This invention relates to subsoil-breaking implements in which in use a blade is forced edgewise through the ground, to break up and fissure the soil at a depth below the ground surface without the need to excavate or remove soil.

The invention comprises various improvements in or modifications of that forming the subject of my patent application No. 41337/73 (Patent No. 1493346) which claims a subsoil-breaking implement for soil cultivation which includes a blade and supporting means supporting the blade at one end, referred to as its upper end, for edgewise forward travel through the ground in a given general-horizontal direction of operative travel with one edge leading, the supporting means holding the blade, when in use, in a slanting attitude with its operative portion extending below the ground surface and down into the subsoil and with the whole or a major portion of the area of each of the two sides of the blade which face transversely to the intended direction of operative travel (referred to as the upper and lower slanting sides of the blade) inclined to the vertical, as viewed in the said direction of operative travel, the operative portion of the blade having a wedge portion of forwardly-tapering cross-section along its leading edge in which portion the blade thickness decreases progressively from a portion of maximum thickness to a cutting edge formed along the said leading edge, which cutting edge generates a slanting surface as the blade is advanced edgewise in the direction of operative travel, and in which the supporting means holds the blade when in use in an attitude such that no part of the surface of the lower slanting side of the operative portion of the blade lies substantially beyond the said generated surface on the side thereof remote from the upper slanting side of the blade, and such that the upper side of the wedge portion of the blade affords a lifting surface behind the cutting edge by which, as the blade is forced edgewise through the soil in the said direction of operative travel, soil will be lifted and displaced locally in a direction away from the lower slanting side of the blade by the passage of the said lifting surface, thereby producing a local disturbance of the soil without any substantial compression of the soil adjacent to the lower slanting side.

According to the present invention, in a subsoil-breaking implement as claimed in Claim 1 of my aforesaid patent No. 1493346, the blade carries at its lower end, referred to as its foot, a fixed tine which projects forwardly of the line of the cutting edge of the blade in the direction of forward travel and tapers to a sharp leading end.

The tine may be of asymmetrical chisel shape in side elevation, its sharp leading end being at or near the level of the bottom surface of the tine and the upper surface of the tapered portion of the tine being upwardly and rearwardly inclined from the leading end towards the cutting edge of the blade.

In one construction the tine may comprise a forwardly projecting portion of a generally-horizontal bar which extends along the foot of the blade. The bar may be detachably secured to the lower end of the blade or it may be rigidly secured to the foot of the blade.

Preferably the bar is of greater thickness than the thickness of the lower end portion of the blade adjacent its foot.

The bar may be straight and of generally-circular cross-section which is uniform at least along that part of its length which lies between the leading and trailing edges of the blade.

It may be advantageous for the bar also to project rearwardly behind the trailing edge

of the blade. The cross-section of the bar in that case may increase rearwardly behind the trailing edge of the blade, or it may remain unaltered.

The portion of the length of the bar lying behind the sharp leading end of the tine may form a ridge which extends along the foot of the blade and projects from the surface of the blade on at least one side thereof.

Preferably, the profile of the blade, as viewed from one side, tapers from its upper end towards its foot, the leading edge of the blade being forwardly and downwardly inclined with respect to the direction of travel, and the trailing edge of the blade being forwardly and downwardly inclined less steeply than the leading edge.

Both the leading and the trailing edges of the blade may be straight.

The blade cross-section may take various forms, but in one form, over the operative portion of the blade its lower slanting side may be relieved behind a line adjacent to but spaced from the leading edge. The said relieved portion of the lower slanting side of the blade may extend rearwardly as far as the trailing edge.

The blade may be formed with a duct extending downwardly from its upper end within the thickness of the blade, or be provided with a duct positioned within a groove formed in the trailing edge of the blade, the duct having an inlet at its upper end and communicating with one or more discharge openings in one or each of the sides and/or to discharge at the trailing edge of the blade, and means for delivering a liquid or gaseous material under pressure, for example compressed air with entrained powder, may be connected to the inlet for delivering the material under pressure through the duct for such discharge.

The invention may be carried into practice in various ways, but certain specific embodiments will now be described by way of example only and with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation of a blade of a subsoiler;

Figure 2 is a front elevation of the blade of Figure 1, looking rearwardly along the line of travel of the blade through the soil;

Figure 3 is a cross-section on a larger scale through the blade on the line III—III of Figure 2;

Figures 4 and 5 are views similar to Figure 3 of two other possible cross-sections for the blade of Figures 1 and 2;

Figure 6 is an exploded perspective view of a construction of blade designed for production;

Figure 7 shows in side elevation another embodiment of the invention in which the slanting blade is formed with longitudinal ducts;

Figure 8 is a cross-section through the blade of Figure 7;

Figures 9 and 10 are respectively a side and rear elevation of the blade of Figure 7 provided with an injection tube located in the channel in the trailing edge, the tube having multiple discharge orifices;

Figure 11 is a view similar to Figure 7 but showing an injection tube with a single elongated discharge orifice at its lower end;

Figure 12 shows in side elevation a supporting frame structure with a set of three of the slanting blades;

Figure 13 is a detailed view in cross-section showing one method of fixing one of the blades to the cross beam of the frame structure;

Figure 14 is a rear view of the assembly of Figure 12;

Figure 15 is a plan of the assembly of Figures 12 and 14;

Figure 16 shows the frame structure of Figures 12 and 14 mounted on the rear of an agricultural tractor;

Figure 17 is a plan of a wheeled carriage supporting a set of three of the slanting blades; and

Figures 18 and 19 are respectively views in side elevation of the wheeled carriage of Figure 17 with the blades in the lowered position for towing through the ground, and in the raised position for transport.

In the embodiment shown in Figures 1 to 3, the blade 10 has plane parallel side faces 11 and 12 and is of downwardly tapering profile, as seen from the side, with a forwardly and downwardly-inclined leading edge formed with a bevel 13 and a cutting edge 13', and a forwardly and downwardly-inclined trailing edge 14' less steep than the leading edge 13'. The upper and lower edges 15 and 16 of the blade are parallel to one another and the edges 13' and 14' of the blade are respectively inclined at approximately 70° and 60° to them. The trailing edge 14' is square-cut as shown in Figure 3. The blade is mounted with its slanting side faces 11 and 12 inclined at approximately 40° to the horizontal, as viewed in Figure 2, with the face 11 lowermost and facing downwardly in the ground in use, and with the upper and lower edges 15 and 16 horizontal, by means of a stalk 17 at its upper end which is detachably secured to a supporting structure to be described. The sharp inclined leading edge 13' lies in the plane of the lower side face 11. The upper slanting face 12 behind the bevel 13 is plane, and diverges at a small acute angle from the lower slanting face 11 and its recessed portion 11C in the direction from the leading edge 13' towards the trailing edge 14', as seen in cross-section in Figure 3.

In use the blade is secured by means of its

stalk 17 to a mounting bracket 18 of channel section, which is secured to a suitable carriage or to a structure attached to the tool bar of a tractor, for example as will be described with reference to Figures 17 to 19 or to Figures 12 to 16 respectively.

Thus, as the blade 10 is advanced edgewise through the soil the soil coming into contact with its leading edge bevel 13 and upper slanting face 12 is eased away upwardly by the bevel surface and the thickness of the blade in a gentle path, the displaced soil being "stretched" and broken up as it flows along the elongated path afforded by the bevel 13 and the upper face 12, and is then free to return to its starting position behind the trailing edge 14', as indicated by the chain line S in Figures 1 and 2.

It will be appreciated that because the blade 10 is slanting at an angle of less than 45° to the horizontal, in this case, the soil being displaced by the bevel 13 will be lifted against only the dead weight of the layer of soil above the blade below ground surface, instead of being compressed horizontally against a solid wall of undisturbed soil, so that the break-up and fissuring action of the blade on the soil will be correspondingly more effective and the traction draft required will be correspondingly lower.

The angle of slant θ of the median plane of the blade 10 to the horizontal is approximately 40° as shown, and is preferably in the range from 30° to 45°. The angle θ may however be less, e.g. between 15° and 20° to the horizontal, and in certain cases it may be greater than 45°, up to say 60° to the horizontal.

In a typical case of the embodiment illustrated in Figures 1 to 3, the blade 10 is 20 inches in vertical depth from its upper edge 15 to its lower edge 16, and is approximately 33 inches in slant length, i.e. measured in the median plane of the slanting blade between the midpoints of the upper and lower horizontal edges 15 and 16. The blade width tapers from 10 inches at the top, measured along the edge 15, to 5 inches at the bottom, measured along the edge 16. The blade also decreases in maximum cross-sectional thickness from 2½ inches at the top to 1 inch at the bottom.

The blade is mounted in an attitude such that the blade will travel edgewise smoothly through the ground with the leading marginal portion of its downwardly-facing lower side face 11 parallel to the direction of travel and in full contact with the soil.

In a modified construction, not illustrated, the blade may be of uniform thickness throughout its length, apart from its bevelled leading and trailing edges 13' and 14'.

The blade can also taper in thickness in the upward direction, instead of in the downward direction as shown in Figure 2.

In every case however, the blade cross-section should be at least 1 inch thick throughout the working length of the blade.

Figures 4 and 5 inclusive illustrate two modified cross-sectional shapes of the blade 10.

However, the under surface 11 is recessed at 11C, rearwardly of a step 20, the recessed portion 11C extending back to the rear edge 14'. The recessed portion 11C of the under surface of the blade reduces soil friction, smearing and traction draft.

Figure 4 is a variation of the shape shown in Figure 3, in which the upper face 12A of the blade is of smooth convexly-curved form in cross-section, the angle of taper decreasing progressively from a maximum at the cutting edge 13' to a minimum towards the rear edge 14'.

Whereas the blade 10 in each of the forms previously described has been described as being mounted in an attitude in which the lower slanting surface 11 is parallel to the horizontal or near-horizontal direction of forward movement of the blade through the soil, Figure 5 shows an arrangement in which when in use the plane of the lower slanting surface 11 is upwardly-inclined rearwardly from the cutting edge 13 at a small acute angle γ to the plane surface 40 generated by the cutting edge 13' as the blade is advanced in the direction of forward movement indicated by the arrow 22. This feature assists in reducing any tendency towards smearing. In Figure 5 the chisel-shaped blade has a plane unrelieved lower slanting face 11, and a bevelled upper face 12, 13.

It will be appreciated that in the arrangements of Figures 1 to 3, 4 and 5, the cutting edge 13' generates a plane slanting surface (40 in Figure 5) as the blade is advanced edgewise in the direction of movement 22, and that no part of the lower slanting surface 11 projects beyond that generated surface on the side remote from the upper surface 12 of the blade. In Figures 3 and 4 the recessed portion 11C lies above the generated surface, whilst in Figure 5 the uptilted lower side 11 diverges upwardly from the generated surface 40 from and to the rear of the cutting edge 13'.

When using a blade in the attitude shown in Figure 5, in which the lower face of the slanting blade is tilted upwardly and rearwardly at angle ψ with respect to the generated surface 40, it is necessary to mount the blade on a supporting structure having ground wheels or the like which follow the ground surface so as to hold the blade rigidly at the required depth. Thus the blade can be mounted rigidly on a wheel trailer, for example as shown in Figures 17

to 19, or on a rigidly-supported tool bar of a wheeled or tracked tractor vehicle. With a blade as shown in Figure 3 or Figure 4, in which the unrecessed leading portion of the lower side of the blade is parallel to the direction of movement, this unrecessed under surface portion 11 bears on the soil beneath it to assist in maintaining correct depth, and a supporting structure providing a "floating" support for the blade can be used, as for example the parallelogram-linkage structure of Figures 12 to 16.

The blade in each of its cross-sectional forms described and illustrated carries a bar 49 which extends along the foot of the blade and projects in front of the line of its leading edge as a sharp nose or tine 50, to assist in entry of the blade into the soil and in depth maintenance. If the bar 49 and its nose 50 are sufficiently large in cross-section, this form of blade can be used in mole-ploughing. The necessary tunnel requires to be made by the mole at the lowest point of the soil disturbance. The bar 49, 50 is of circular cross-section and is rigidly secured to the lower edge 16 of the blade. The leading portion of the tine 50 has a down-slanting upper surface forming a sharp leading end 51. The bar 49 extends with its full diameter along the whole length of the foot of the blade, and projects as a ridge along the upper and lower side faces of the blade. The bar 49 may also project rearwardly behind the trailing edge of the blade, its cross-section possibly increasing rearwardly behind the blade; alternatively or in addition a separate cylindrical or flared mole bullet or expander tube can be secured to the rear end of the bar 49, or to the trailing edge of the blade behind the bar, by means of a pivotal connection or a link or a series of links, so as to be towed behind the foot of the blade.

The bar 49 may be rigidly attached to the foot of the blade or detachably secured to the lower end of the blade, and it need not be circular but could be of some other cross section, for example a triangular bar. The bar will perform a valuable function in reducing wear on the blade 10. For example the bar 49 may comprise part of a replaceable wear member, and may also be longitudinally adjustable to compensate for wear.

Figure 6 shows in exploded view a modified design of the blade arrangement in a version suitable for production. The blade is constructed as a body plate 10A' to the under side of which is welded a triangular-section channel strip 58 having a reinforcing web 58' the strip 58 affording the recessed rearward part 11C' of the lower slanting surface of the blade. The forward part of the lower slanting surface is afforded by a shallow bevel 59' on the body plate 10A' in front of the sloping step 20'. The blade is provided with the two detachable hardened steel strips 55', 56' which have bevelled cutting edges 13' on both longitudinal edges so that they are reversible as well as interchangeable. The strips 55', 56' can be bolted onto the body plate 10A' by bolts and nuts 60, with the leading cutting edge 13' projecting forwardly of the edge of the body plate 10A' to a level in or below the plane of the bevel 59'. A detachable foot 52' with a forwardly projecting chisel-shaped nose tine 50' is detachably secured to the body plate 10A' by bolts and nuts 54'. The foot 52' has an integral ridge formation 49' along its upper face which forms an extension of the nose tine 50' and corresponds to the bar 49 of Figure 1.

It will be seen that the cross-section of the blade of Figure 6 corresponds generally to that shown in Figure 3.

One advantage of the bevelled or convex blade sections with recesses as shown in Figures 3 and 4 arises from the fact that it is found in practice that the cutting edge of the blade need not be acutely sharp, but the blade will funtion satisfactorily with a cutting edge having a radius of up to 1/8th inch. Accordingly a slanting blade 10 with a recessed lower slanting surface can be made progressively self-sharpening as the unrecessed leading portion of the under surface 11 becomes progressively worn away.

Each of the various slanting blade constructions previously described and illustrated can be pivotally mounted for tilting about a transverse horizontal axis, and provided with an adjusting ram in the manner described with reference to Figures 6 and 7 of my patent application No. 41337/73 (Serial No. 1493346).

In order to improve grassland by a subsoiling treatment, the slant of the or each blade 10, etc., which penetrates into the ground normally commences above ground level.

For particular purposes where land drainage or soil processing or enrichment treatment is required an implement with an inclined soil blade as described and illustrated can be utilised for placing a liquid, granular or particulate material in a part of the slot or passage formed in the soil by the blade as it is towed through the ground, or into the adjacent soil above or below the slanting blade. For this purpose one or more ducts can be provided within the thickness of the inclined blade, with corresponding openings at the base or the rear of the blade, or through any associated expander or mole, or elsewhere in the blade, for example in the upper or lower faces of the slanting blade, by means of which liquid, powder or granular material may be fed.

Thus Figures 7 and 8 show a modified slanting blade construction which is basically similar to that shown in Figures 1 and 2 but which has a cross-section as shown in Figure 8. The blade shown in Figure 7 and 8 is formed with a longitudinal channel 70 in its trailing edge 14F, the width of the channel from front to rear decreasing progressively in the downward direction, which channel terminates shortly above the foot of the blade. A duct 71 is formed in the thickness of the blade 10 and is closed at its upper end by a nozzle fitment 72 through which liquid, gaseous or granular material, e.g. compressed air carrying entrained powder material, can be delivered under pressure into the duct 71 and discharged through holes 73 formed in the upper face, and/or the lower face of the slanting blade.

In the construction shown in Figures 9 to 11, a pipe 74 is mounted in the channel 70 to extend from above ground in use, where it communicates with a blower or other pressure fluid supply means (not shown), down to the lower end of the channel, the pipe 74 having either a single large opening 75 at its lower end as shown in Figure 11 or a series of openings 76 spaced along its length as shown in Figures 9 or 10. The openings 75 and 76 face rearwardly out of the channel 70, which is closed at its upper part by means of a cover plate 77 located above the uppermost opening 76.

In the arrangements of Figures 9 and 10 the blade may, if required also be formed with an internal duct 71 and side discharge openings 73, the nozzle 72 of duct 71 being connected to the pressure fluid supply instead of, or in addition to, the pipe 74.

Granular, powdered or fluid material, for example pesticides, herbicides, soil treatment materials or chemicals, fertilisers or drainage aggregate, can be passed or blown down the pipe 74 and out through the single opening 75 into the soil at the required depth; or through the pipe 74 and the multiple openings 76 and/or through the duct 71 and side openings 73, into the soil throughout the full depth of soil layer from the ground surface down to the depth of the lowermost opening. This material will be injected into the loose soil which has been broken up and fissured by the passage of the blade, so that it will penetrate fully into the loosened soil above (and possibly below) the blade, or rearwardly into the loosely-filled slot left by the passage of the blade. If the material is blown with a sufficient air or liquid pressure its penetration will be increased, even upwardly to the soil surface level.

A set of the slanting blades 10, etc of any of the constructions herein described with reference to the drawings may be mounted on a supporting frame structure 100 as shown in Figures 12 to 16 for attachment to the 3-point lifting linkage of an agricultural tractor. The frame 100 is of generally triangular form in plan, having an angle beam 101 constituting a form of tool bar on which three of the slanting blades 10, 10' and 10'' are mounted in staggered relationship. The channel-section mounting bracket 18 (Figures 1 and 2) of each blade 10, etc is attached at its rear by a pin through the hole 102 to a short rigid box-section member 103 which is welded to the underside of the angle beam 101 and extends in the direction of forward movement of the apparatus. At its leading end each mounting bracket 18 is clamped to the member 103 by means of a U-shaped stirrup 104. The stirrup 104 provides a fail-safe member which breaks to allow the bracket 18 and blade 10 to pivot rearwardly in the event of the blade striking an immovable obstacle at or below ground level. Alternatively a fixing arrangement utilising a conventional shear pin as the "fail-safe" member may be employed.

The frame 100 has a pair of braced upstanding arms 106 which converge and between whose upper ends the rear end of an upper link 107 is secured by a high-level pin-and-hole connection 108. The frame 100 also has two pairs of low-level apertured mounting brackets 109 rigidly secured to it on opposite sides of the frame, to which the rear ends of a pair of lower links 111 are pivotally connected. The front ends of the upper link 107 and of the lower links 111 are pivotally connected to the three attachment points A1, A2 and C of the tractor three-point lifting linkage, providing a floating drawbar arrangement by which the frame 100 and the three blades 10, 10' and 10'' are towed forwardly, the blades taking up their own level in the soil. A hydraulically-powered lifting ram 112 acts on a pair of levers 113 which are connected by chains 114 to the lower links 111 for raising the frame 100 or holding it at a required level.

As already mentioned, when using a supporting structure with a "floating" action such as that of Figures 12 to 16 to support the blades, the blades must be set up in an attitude in which the under surface 11 of each blade, or at least its unrecessed leading portion, is parallel to the direction of forward movement, i.e. horizontal when on level ground, to ensure that the blades will take up and maintain the required depth.

Figures 17 to 19 show another arrangement in which the set of three blades 10, 10' and 10'' is supported by means of a wheeled carriage 120 which can be towed behind a tractor. The carriage 120 comprises a frame 121 whose rear part includes an angled tool beam 122 similar to the beam 101 of Figures 12 to 15, on which

the three slanting blades 10, 10' and 10'' are mounted in echelon in the same way as in Figures 12 to 15. The leading portion of the frame 121 constitutes a drawbar portion and terminates a towing eye 123. Large-diameter wheels 124 are mounted on pivoted legs 125 one on each side of the frame, and a pair of hydraulic rams 126 pivoted to a yoke 127 which is secured to the frame 121 act on the respective legs 125 for adjusting the level of the frame 121 relative to the wheels 124 and hence relative to ground level. In this case since the wheels 124 by engagement with the ground surface positively hold the frame 121 at a required height and the blades at a required depth, the blades may if desired be set up in an attitude as shown in Figure 5 with the lower surface of each blade inclined rearwardly and upwardly from the cutting edge, with respect to the generated surface 40, with a view to reducing traction draft and minimising any soil smearing below the blade.

WHAT I CLAIM IS:—

1. A subsoil-breaking implement as claimed in Claim 1 of Patent No. 493346, in which the blade carries at its lower end, referred to as its foot, a fixed tine which projects forwardly of the line of the cutting edge of the blade in the direction of forward travel and tapers to a sharp leading end.

2. An implement as claimed in Claim 1, in which the tine is of asymmetrical chisel shape in side elevation, its sharp leading end being at or near the level of the bottom surface of the tine and the upper surface of the tapered portion of the tine being upwardly and rearwardly inclined from the leading end towards the cutting edge of the blade.

3. An implement as claimed in Claim 1 or Claim 2, in which the tine comprises a forwardly projecting portion of a generally-horizontal bar which extends along the foot of the blade.

4. An implement as claimed in Claim 3, in which the bar is of greater width than the width of the lower end portion of the blade adjacent its foot.

5. An implement as claimed in Claim 3 or Claim 4 in which the bar is straight and is of generally circular cross-section which is uniform at least along that part of its length which lies between the leading and trailing edges of the blade.

6. An implement as claimed in any one of Claims 3 to 5 in which the bar also projects rearwardly behind the trailing edge of the blade.

7. An implement as claimed in Claim 6 in which the cross-section of the bar increases rearwardly behind the trailing edge of the blade.

8. An implement as claimed in any one of Claims 3 to 7 in which the bar is detachably secured to the lower end of the blade.

9. An implement as claimed in Claim 8 in which the portion of the length of the bar lying behind the sharp leading end of the tine forms a ridge which extends along the foot of the blade and projects from the surface of the blade on at least one side thereof.

10. An implement as claimed in any one of the preceding claims, in which the profile of the blade, as viewed from one side, tapers from its upper end towards its foot, the leading edge of the blade being forwardly and downwardly inclined with respect to the direction of travel, and the trailing edge of the blade being forwardly and downwardly inclined less steeply than the leading edge.

11. An implement as claimed in Claim 10 in which both the leading and the trailing edges of the blade are straight.

12. An implement as claimed in any one of the preceding claims, in which over the operative portion of the blade its lower slanting side is relieved behind a line adjacent to but spaced rearwardly from the leading edge.

13. An implement as claimed in Claim 12 in which the said relieved portion of the lower slanting side of the blade extends rearwardly as far as the trailing edge.

14. An implement as claimed in any one of Claims 1 to 13, whose blade is provided with a duct positioned within a downwardly-extending groove formed in the trailing edge of the blade, the duct having an inlet at its upper end and having one or more discharge openings below its upper end, in combination with means connected to the said inlet for delivering fluid material under pressure through the duct for discharge through the discharge opening or openings.

15. An implement as claimed in any one of the preceding claims, whose blade is formed with a duct extending downwardly from its upper end within the thickness of the blade, the duct having an inlet at its upper end and communicating with one or more discharge openings in one or each of the sides and/or to discharge at the trailing edge of the blade, in combination with means connected to the said inlet for delivering a liquid or gaseous material under pressure, for example compressed air with entrained powder, through the duct for such discharge.

16. A subsoil-breaking implement substantially as specifically described herein with reference to Figures 1 to 3 of the accompanying drawings.

17. A subsoil-breaking implement substantially as specifically described herein

with reference to Figures 1, 2 and 4 of the accompanying drawings.

18. A subsoil-breaking implement substantially as specifically described herein with reference to Figures 7 and 8, or to Figures 9 and 10, or to Figure 11, or to Figures 12 to 15, or to Figures 17 to 19 of the accompanying drawings.

KILBURN & STRODE,
Agents for the Applicants.

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1574412 COMPLETE SPECIFICATION

6 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

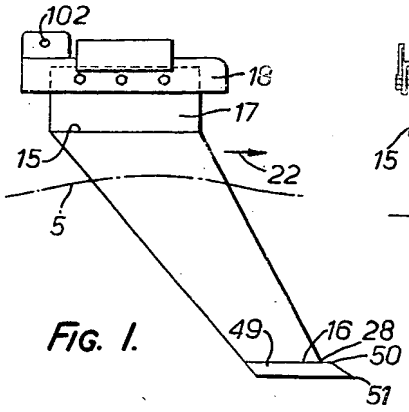

FIG. 1.

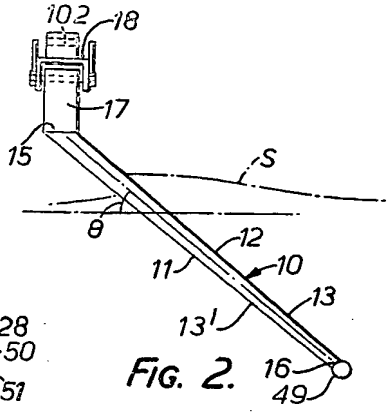

FIG. 2.

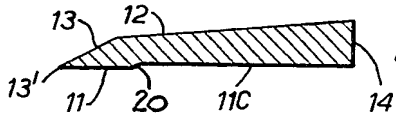

FIG. 3.

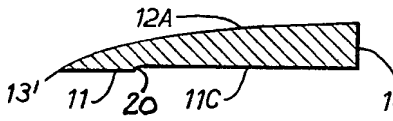

FIG. 4.

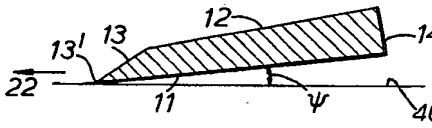

FIG. 5.

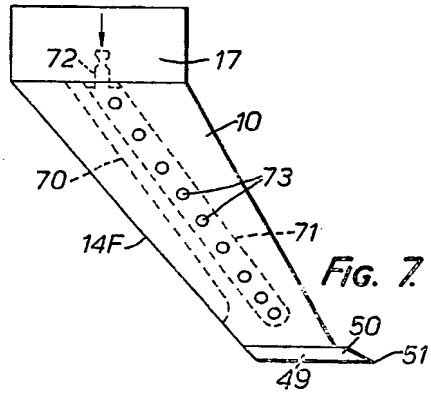

FIG. 7.

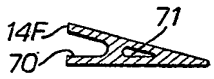

FIG. 8.

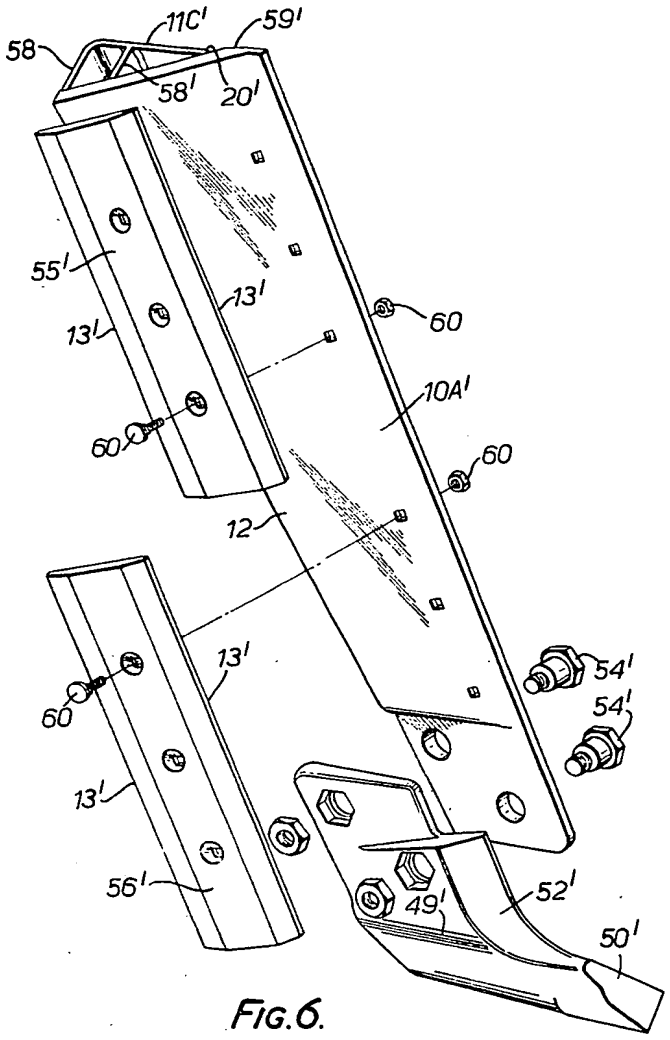

FIG. 6.

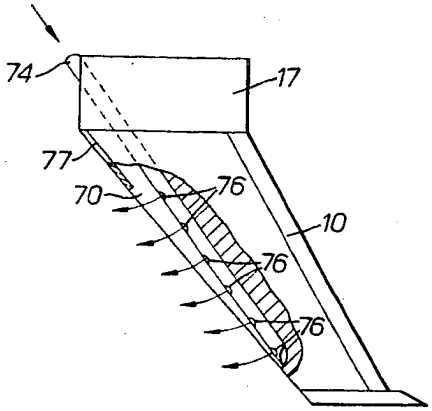

FIG. 9.

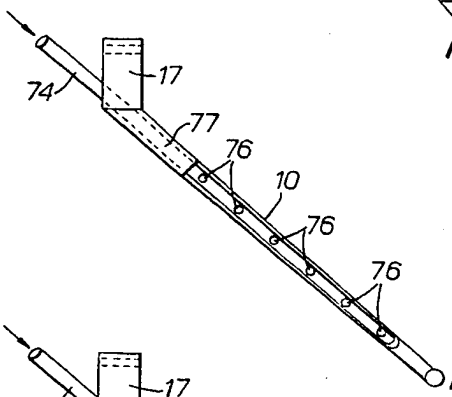

FIG. 10.

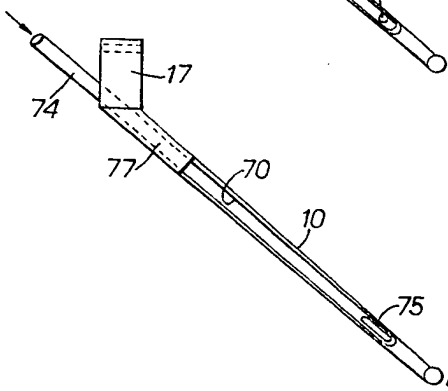

FIG. 11.

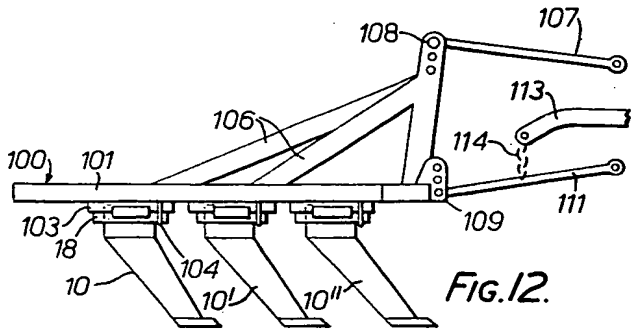

FIG.12.

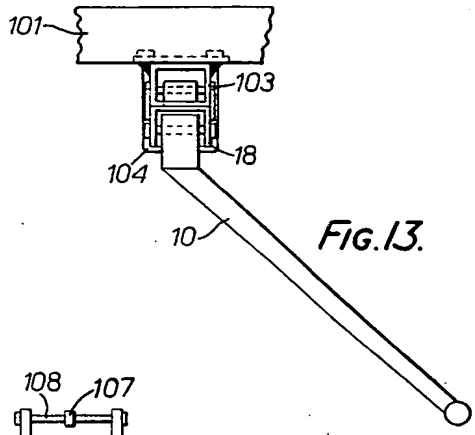

FIG.13.

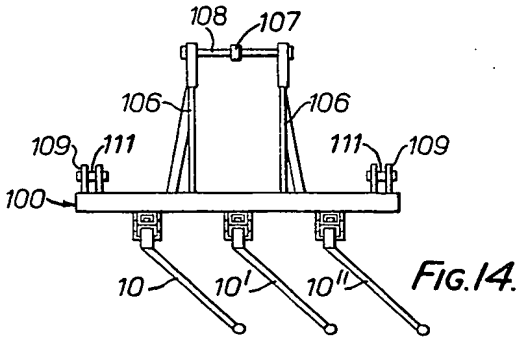

FIG.14.

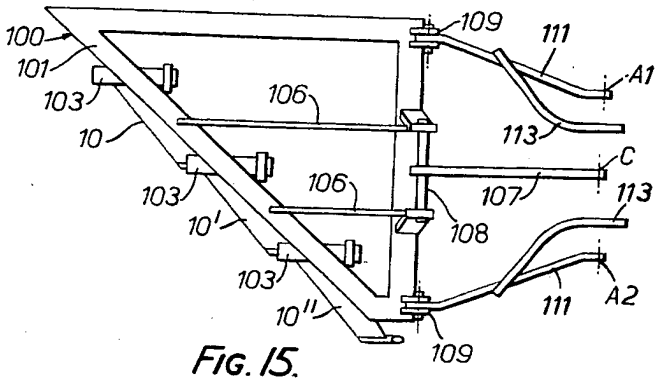

FIG. 15.

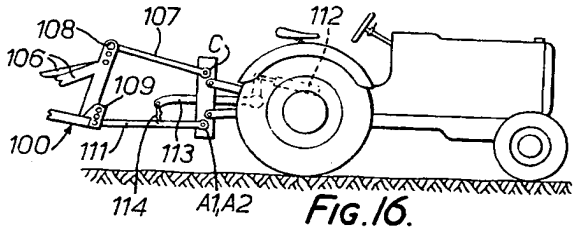

FIG. 16.

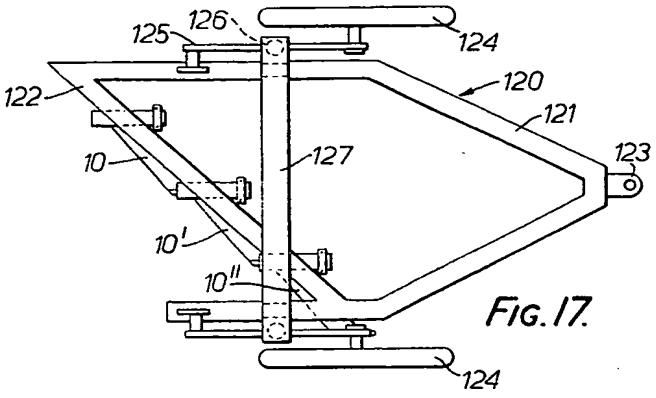

FIG. 17.

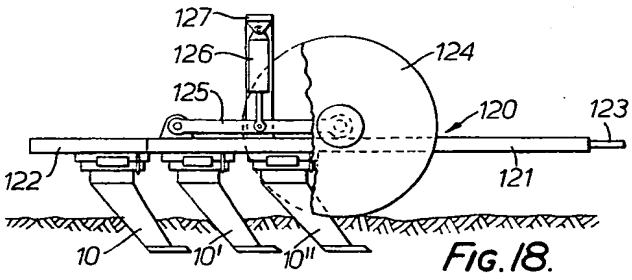

FIG. 18.

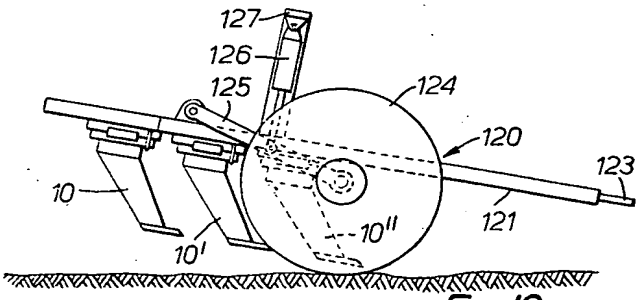

FIG. 19.